



POLICY PAPER SERIES #2

India's Energy Options: the Road Ahead

**AN ANALYSIS OF THE PROSPECTS OF SHALE GAS IN INDIA'S ENERGY
FUTURE**

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Foreword

The Third India-U.S. Strategic Dialogue held on June 13, 2012 gave considerable importance to bilateral cooperation in the area of energy, including cooperation on shale and other unconventional gas potential in India, hydrocarbon potential in the Indian Ocean, stable supplies of natural gas for India and India's interest in LNG imports from the U.S.

Similarly, the India-U.S. Energy Dialogue held on September 20, 2012 welcomed the enormous trade and investment opportunities which have opened up with the discovery of U.S. shale gas. While noting the investments already made in this sector by Indian companies and the permission granted to GAIL for the export of LNG from the Sabine Pass terminal in the U.S. to India, the Dialogue also discussed the impact of relatively less expensive LNG imports from the U.S. on India's economic growth.

Given the critical importance of energy security to India's economy as well as growing cooperation between India and the U.S. on energy issues, this policy paper examines the future of India's energy options and provides an analysis of the prospects of shale gas in India's energy mix.

The authors would like to record their gratitude to Ambassador Chandrashekhar Dasgupta, Distinguished Fellow at The Energy and Resources Institute (TERI), New Delhi, for his valuable advice. The recent CSIS report "Prospects for Shale Gas Development in Asia – Examining Potentials and Challenges in China and India", published in August 2012, provided added motivation and useful information for this policy brief.

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Abbreviations

CBM	Coal Bed Methane
CIL	Coal India Limited
DGH	Directorate General of Hydrocarbons
EIA	U.S. Energy Information Administration
EU	European Union
FTA	Free Trade Agreement
GSPC	Gujarat State Petroleum Corporation
IEA	International Energy Agency
KG-D6	Krishna Godavari block no. D6
LNG	Liquid Natural Gas
MMBTU	Million British Thermal Units
MMSCMD	Million Metric Standard Cubic Meters per Day
MMT/y	Million Metric Tonnes per year
MOU	Memorandum of Understanding
MW	Megawatt
NPCIL	Nuclear Power Corporation of India Ltd.
ONGC	Oil and Natural Gas Corporation Limited
RIL	Reliance Industries Limited

I. India's Struggle for Energy Security

The twin power blackouts of late July 2012 that plunged the better part of a billion people into darkness were a grim reminder that India is approaching the precipice of a severe energy crisis. With its burgeoning economic and population growth of the past two decades, energy demands have soared. Despite a scramble to expand the country's power generation capacity through the construction of power plants, India has struggled to keep pace with the growing demand for power and the ensuing shortfall has grown ever larger. Today, the country's peak power shortage already stands at approximately 12%, a particularly unacceptable statistic for any emerging economy aspiring to the status of a world power.¹ The gravity of the situation becomes more pronounced when one considers that over 300 million of the country's population are yet to receive their first electricity connection.² With demand expected to rise by 7-8% annually in the coming decade, the situation is certainly trending towards critical.³

The government appears to have grasped the urgency. Addressing top officials at a meeting on infrastructure in June 2012, Prime Minister Manmohan Singh prioritized the power sector, pledging 40% of the aggregate \$1 trillion in expenditure over the 12th Five Year Plan (2012-17) to the sector, while promising a record 18,000 MW expansion in generation capacity within the current financial year to set the ball rolling.⁴

However, along with the expansion of generation capacity, concurrent securing of stable and ample fuel supplies is key, as the debacle with India's underperforming coal sector has shown.

¹ Sanjay Jog, "Power Deficit for 2011-2012 Pegged at 10.3 percent", *Business Standard*, June 13, 2011, <http://www.business-standard.com/india/news/power-deficit-for-2011-12-pegged-at-103-percent/438884/>

² "World Energy Outlook: 2011" *International Energy Agency*. Web. <http://www.worldenergyoutlook.org/resources/energydevelopment/accesstoelectricity/>

³ Ibid

⁴ "Singh Vows to Revive Indian Growth by Adding Roads, Ports." *Bloomberg News*, Jun 7, 2012. web <http://www.bloomberg.com/news/2012-06-06/singh-vows-to-add-roads-ports-and-plants-to-revive-india-growth.html>

Diminishing Primacy of Coal

For over a century, coal has been cheapest source of power and the staple of the country's energy economy (Figure 1). However, it is increasingly evident that coal is not the long-term answer to the country's energy problems. Even as the third largest producer of coal in the world on aggregate, India has been unable to meet its domestic demand shortfall.⁵ According to the Central Electricity Authority, 18 of 89 coal-fired power stations in the country were recently rated with "super-critical" stockpiles, or less than four days of supply, and 33 had less than seven days.⁶ Due to sagging domestic production and logistical bottlenecks, Coal India Ltd. (CIL) has estimated that it will only be able to supply 65% of the requirement to Indian power plants built after December 2009.⁷ As a result, an increasing proportion of India's coal demand has to be met through imports to compensate for the supply shortfall of 70 million tonnes, roughly 12% of the country's coal consumption.⁸

Major investments to bring India's coal infrastructure to par is certainly an option on the table. However, keeping in mind the adverse environmental impact of coal-based power and the poor quality of domestic reserves, it makes little sense to invest heavily in the resource when other cleaner and economically competitive alternatives are available.

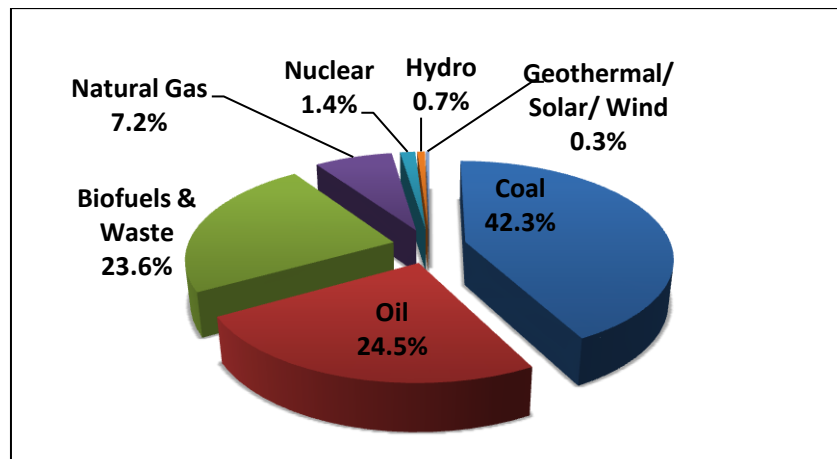
⁵ "International Energy Statistics: Total Primary Coal Production 2007-2011." in *Independent Statistics and Analysis*, U.S. Energy Information Administration. Web. Accessed October 1, 2012. <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=1&pid=7&aid=1&cid=all,&syid=2007&eyid=2011&unit=TST>

⁶ Singh, Rajesh K. and Katakey, Rakteem. "Worst India Outage Highlights 60 Years of Missed Targets." *Bloomberg News*, August 1, 2012. Web. <http://www.bloomberg.com/news/2012-08-01/worst-india-outage-highlights-60-years-of-missed-targets-energy.html>

⁷ "Power ministry agrees for coal price pooling model." *The Economic Times*, July 20, 2012. web http://articles.economictimes.indiatimes.com/2012-07-20/news/32764625_1_coal-india-coal-prices-coal-ministry

⁸ Ibid.

Figure 1: India's Energy Mix



Source: IEA International Energy Statistics

Evaluation of Alternatives

The India-U.S. Strategic Dialogue held on June 13, 2012 welcomed much-awaited progress towards the full implementation of the historic Civil Nuclear Agreement between the two countries, with the signing of a MOU between Westinghouse and NPCIL, and a similar accord between GE-Hitachi and NPCIL likely in the near future.⁹ The dialogue stressed the importance of collaboration efforts towards the development and deployment of clean energy and renewables. The India-U.S. Energy Dialogue held on September 28, 2012 also called upon both countries to enhance cooperation on energy generation from renewable and low carbon resources. It would be useful, therefore, to assess prospects for the respective roles of nuclear and renewable energy.

Certainly, an energy future where nuclear power sustainably shares India's power generation burden in conjunction with renewable sources would be a highly desirable scenario. However, one need only glance at India's power mix shown in Figure 1 to understand that this is as yet a remote prospect.¹⁰

⁹ "Joint Statement on the Third US-India Strategic Dialogue" U.S. Department of State, June 14, 2012. Web. Jun 27, 2012. <http://www.state.gov/r/pa/prs/ps/2012/06/192267.htm>

¹⁰ "IEA Energy Statistics." International Energy Agency. Web. September 15, 2012. http://www.iea.org/stats/pdf_graphs/INTPESPI.pdf

India's six nuclear power plants currently generate roughly 4,800 MW of electricity accounting for a mere 2.1% of the total installed power base.¹¹ The four major plants under construction at Kudankulam, Kalpakkam, Kakrapar and Rawatbhatta should just about double the installed capacity upon completion.¹² In the optimal scenario, India's plan is to achieve 63,000 MW from nuclear sources by 2032.¹³ However, with India's demand expected to rise dramatically by 6.9% annually until 2022 and by 4.9% thereafter, nuclear power's share in the overall energy mix will likely remain below 10% by 2030 even in the best-case scenario.¹⁴

Renewable sources of power, though they have great potential for the future, are as yet relatively expensive across the board. New innovative technologies and production methods are expected to drive down costs, though this timeline is uncertain. Should the country attempt to transition to the more expensive renewable sources prematurely, the increased cost of power would drive up inflation and become a severe burden on the country's economy. It is, therefore, clear that even though nuclear power and the various renewable sources may be the answer for the future, they are not the immediate solution, quite possibly for another quarter century or more.

With a gap materializing between its immediate energy needs and long-term solutions, what India needs is a 'bridge fuel', a transitional recourse between the 'hard' conventional fossil fuel derived power and the technologies of the future. Natural gas is the best available option to fill this niche role.

¹¹ "India eyeing 64,000 MW nuclear power capacity by 2032: NPCIL". *The Economic Times*. 11 October 2010. print

¹² "Projects Under Construction". *NPCIL*. Web. 20 July 2012.

¹³ "India eyeing 64,000 MW nuclear power capacity by 2032: NPCIL". *The Economic Times*. 11 October 2010. print

¹⁴ Kakodkar, Anil, "Energy in India in the Coming Decades" *Department of Atomic Energy*, March 2005. Web. September 18, 2012.
http://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CCgQFjAB&url=http%3A%2F%2Fwww.dae.gov.in%2Fni%2Fnijul05%2FPDF%2F05_Energy%2520India.pdf&ei=MIBRUJWmG4PprAe73YC4Dw&usg=AFQjCNEVrxnerlAn7qldg_qDj1rtNzMJcQ

II. The Natural Gas Option

In recent decades, the world has been looking for new paradigms in energy technologies, including fusion power. Natural gas, occurring naturally for millennia and harnessed as an energy source for two centuries, has appeared an unlikely answer. However, in the past 15 years, quantum advances in extraction technology in the Oil and Gas industry have brought the prospects of plentiful natural gas from unconventional sources to the forefront. Among these, perhaps the most significant is the development of hydraulic fracturing (or *fracking* as it is commonly known) as well as horizontal drilling techniques in the U.S. which has allowed firms around the globe to finally tap into deep geological repositories of *shale gas* (natural gas trapped in subterranean shale formations) that were previously either inaccessible or economically unviable to extract.

Meanwhile, significant discoveries of gas reservoirs in offshore shale formations in the Krishna-Godavari basin off India's East coast have been made in the past decade, beginning with Reliance Industries' discovery of 14 trillion cubic feet (tcf) in the KG-D6 block in 2002. These have prompted investments of over Rs. 40,000 crores (US\$ 7.5 billion) in the construction of supporting infrastructure including receiving terminals and pipelines, as well as gas-based power plants, to harness this resource for the nation's billion-plus inhabitants.¹⁵

Estimates made by the U.S. Energy Information Administration in 2010 have pegged India's recoverable shale-gas resources to be around 63 tcf¹⁶. These could bolster India's energy security and raise the profile of gas in its energy mix in the coming years.

¹⁵ "Kiran Kumar Reddy Urges PM to Look into KG Basin Gas Production Issue." *The Economic Times*, August 22, 2012. Web. http://articles.economictimes.indiatimes.com/2012-08-22/news/33322316_1_gas-production-gas-shortage-power-plants

¹⁶ Pfeifer, Silvia, "Finds that form a bedrock of hope", *Financial Times*, April 22, 2012. Web <http://www.ft.com/intl/cms/s/0/e04264c8-8a2e-11e1-a0c8-00144feab49a.html#axzz2702pkwB9>

Unmet Expectations in Domestic Production

Despite a highly promising start, in the ten years since Reliance's gas discovery in KG-D6, things have not played out as anticipated. Over 8,000 MW of India's installed gas-based power generation capacity lies idle today as anticipated production from Reliance's KG-D6 block has slumped significantly.¹⁷ Gas output from the block has fallen to 26 million metric standard cubic meters/day (MMSCMD) on average in 2012,¹⁸ down from 62 MMSCMD in the previous year and well below a projected output of 80 MMSCMD for the same period, and is expected to continue declining.¹⁹ The underlying cause for the fall in supply is a matter of dispute. The company claims that the quantity of actual recoverable resources in the block is much smaller than initially anticipated. The government has turned down requests for raising the price of gas²⁰.

In the meanwhile, development of other sites where significant discoveries of recoverable shale-gas resources were made by Reliance, Gujarat State Petroleum Corporation (GSPC) and Oil and Natural Gas Corporation of India (ONGC) has been slow and is unlikely to reinforce falling supplies from KG-D6 anytime soon. As a result, the near-term prospects for unconventional gas in India have been deflated, prompting many to prematurely announce the end of the road for India's gas ambitions.

The Medium to Long-term Outlook

Skeptics are missing the mark. In the years to come, gas is set to increasingly become a staple bridge fuel for developed and developing economies the world over and India is

¹⁷ "Kiran Kumar Reddy Urges PM to Look into KG Basin Gas Production Issue." *The Economic Times*, August 22, 2012. Web. http://articles.economictimes.indiatimes.com/2012-08-22/news/33322316_1_gas-production-gas-shortage-power-plants

¹⁸ Jaiswal, Rajeev. "Oil Ministry Blames Reliance Industries Limited for KG-D6 Development Delays." *The Economic Times*, October 15, 2012. Web. articles.economictimes.indiatimes.com/2012-10-15/news/34473393_1_kg-d6-petroleum-secretary-gc-chaturvedi-cag-audit

¹⁹ Ghosh, Ravichandran et. al. "Indian Downstream Natural Gas Sector Ballooning Natural Gas Supply-Demand Deficit to Fuel LNG Imports", *ICRA*, October 2012, Web <http://www.icra.in/Files/ticker/Indian%20Downstream.pdf>

²⁰ Dutta, Sanjay. "Reliance Request for Gas Price Hike Rejected" *Times of India: India Business*, October 12, 2012. Times News Network. Web <http://timesofindia.indiatimes.com/business/india-business/RIL-request-for-gas-price-hike-rejected/articleshow/16774575.cms>

unlikely to be an exception. In spite of weak domestic production, India's appetite for gas is set to only grow further. According to S. Jaipal Reddy, India's Cabinet Minister for Petroleum and Natural Gas, the country's current consumption of 166 MMSCMD is likely to rise to approximately 473 MMSCMD by 2017.²¹ The major underlying causes can be narrowed down to the following:

- i. **Diminishing Economic Competitiveness of Coal:** Coal has been the staple of India's power production largely due to a significant price advantage over other alternative fuels. However, with domestic coal production stagnating, an increasing proportion of India's coal needs are met by imported coal which is priced between U.S. \$75 and \$100 per tonne, considerably more expensive than domestic coal which is available for between \$15 and \$35 per tonne.²² With the government set to introduce price-pooling measures that will average the price of coal between domestic and imported quantities across the board for all end-users, coal as a fuel will become more costly.²³ The rising average cost of coal will make it progressively less competitive against other alternatives, particularly domestically produced gas which in some instances is priced below \$6.6 per million British thermal units (mmbtu) and is cheaper than imported coal, thus presenting an attractive alternative.²⁴
- ii. **Overall Cost-effectiveness:** Advances in technology, including the introduction of combined gas-cycle turbines, have led to vast improvements in efficiency and costs of gas-based power generation.²⁵ Consequently, gas-fired power plants require substantially lower time and capital investments to build than nuclear or hydro-electric power projects and in most cases are cheaper than renewable power alternatives over similar project lives.

²¹"India's gas demand to rise to 473 mcmd by 2017." *The Times of India*, May 23, 2012, Web. <http://timesofindia.indiatimes.com/business/india-business/Indias-gas-demand-to-rise-to-473-mcmd-by-2017/articleshow/13409819.cms>

²²"Coal India may hike coal price." *Deccan Herald*, August 25, 2012. Web. September 26, 2012. <http://www.deccanherald.com/content/21392/coal>

²³ Ibid.

²⁴"Natural Gas Prices Should Be Determined by Market Forces", *Business Standard*. September 23, 2012

²⁵"An Unconventional Bonanza." *The Economist* July 14, 2012: 43. Print

- iii. **Industrial Applications:** Due to its versatile properties, natural gas is in demand for a variety of industries, from petrochemicals to feedstock for fertilizers. Despite the current downturn in India's industry, its manufacturing sector is expected to see steady growth through the next two decades. Coupled with growing demand for fertilizers from the agricultural sector, this is expected to be a significant driver of demand for natural gas.

- iv. **Low Environmental Impact:** Gas is a far cleaner alternative to coal, producing about one half the emissions per unit of power produced.²⁶ Until even cleaner renewable sources of power become more prevalent, gas will certainly hold the edge over other conventional fossil fuels from an environmental perspective.

Considering the above factors cumulatively, there is a high likelihood that the demand for natural gas will rise substantially in the coming decade and beyond. The challenge will be the provisioning of gas to meet this growing demand.

²⁶ An Unconventional Bonanza." *The Economist* July 14,2012: 43. Print

III. Assessing Options for Procurement

India's Domestic Shale Gas Potential

Even as India's unconventional gas industry stagnates in the near-term, it is essential that the country continues to advance exploration and development of its own resources towards the longer term goal of achieving greater self-sufficiency in gas production. By most estimates, India has a substantial domestic shale-gas resource base. However, these estimates vary widely (Table 1).

Table 1: Estimates of Indian Shale Gas

Source	Year of Study	Shale Resource Estimate
U.S. Energy Information Administration	2011	63 tcf
U.S. Geological Survey	2012	6.1 tcf
Schlumberger	2010	500-2,000 tcf

Source: ICF International

The most frequently cited estimates are attributed to the U.S. Energy Information Administration, which puts India's total recoverable shale-gas resources at 63 tcf. However, a more recent U.S. Geological Survey (USGS) report published in January 2012, which assessed the Cambay, Cauvery and Krishna-Godavari basins, three of India's most promising regions, downgraded the total recoverable resources to a mere 6.1 tcf. In contrast to both these assessments, Schlumberger, a U.S. based oilfield services firm contracted by ONGC to assist in the exploration of India's shale-resource potential, estimated that India could have

between 500-2,000 tcf of shale gas.²⁷ Schlumberger's assessment, if correct, could place India on the top of the league in terms of potential recoverable shale-gas resources, as the U.S. and China, by way of comparison, are estimated to have 1,250 tcf and 1,275 tcf of gas respectively.²⁸

The caveat is that Schlumberger's estimate refers to *gas in place* as opposed to *recoverable gas*, as all the gas in place in a particular basin may not be recoverable due to various technical limitations. A report released in March 2012 by ICF International analyzed each of the three estimates and the respective methodologies used to shed some light on the causes for the variations, concluding that the EIA and USGS studies assessed only a relatively small number of formations within each basin, and thus represented only a small subset of all of India's potential shale-gas bearing basins (see Map 1 on next page).²⁹ The vast majority of the country's potential gas-yielding regions remain unexplored. The report also stated that Schlumberger conducted the most comprehensive of the three assessments, while noting that USGS estimates have been proven to be overly conservative in previous instances in the U.S. The ICF report concluded that the mean expected potential for shale gas in India is significantly larger than the USGS or EIA estimates.³⁰ If Schlumberger and ICF International's forecasts are correct, then the future for India's shale gas, and consequently its overall energy security, is potentially bright.

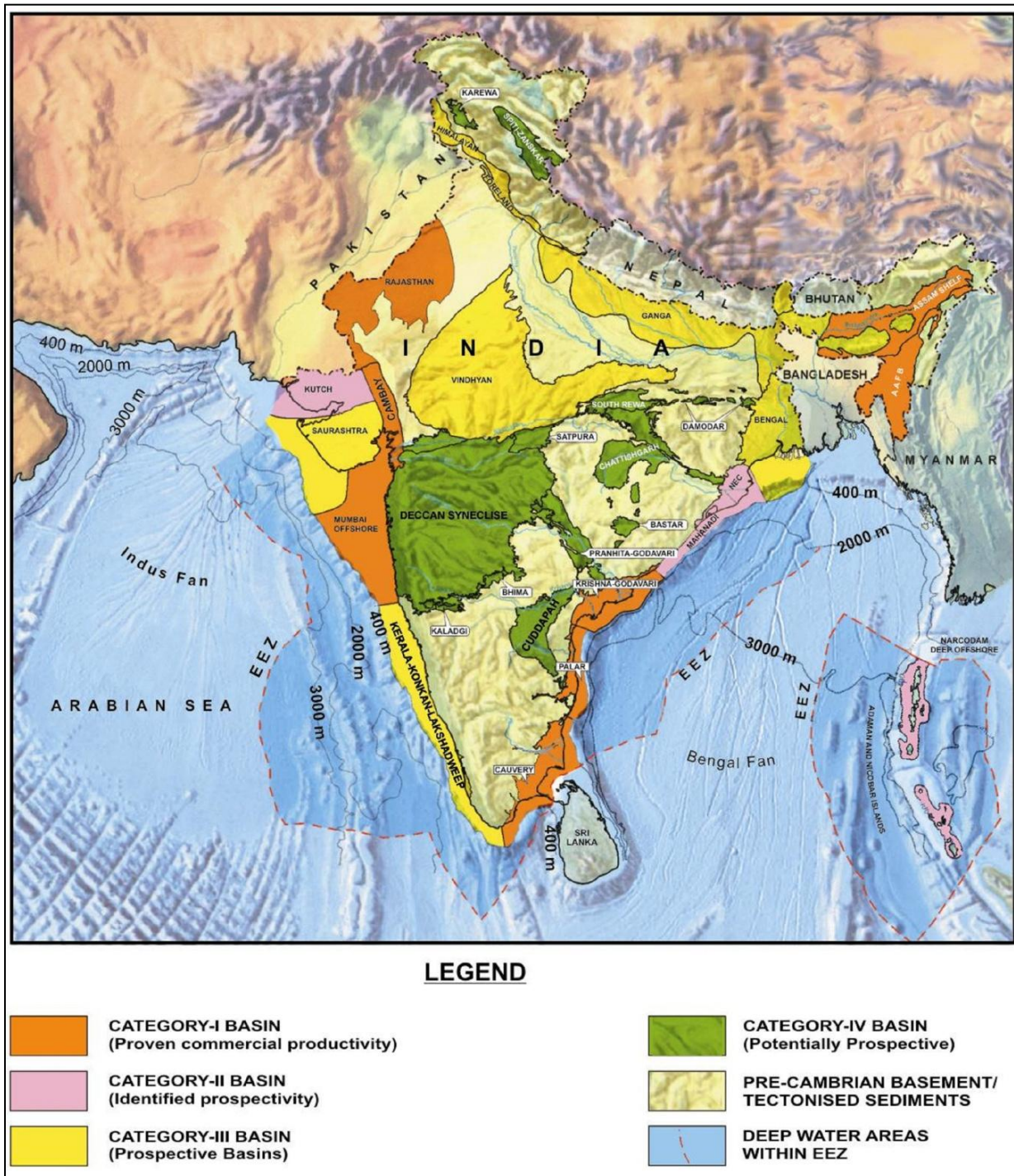
²⁷ Thakkar, Mittul. Economic Times, January 10, 2011 as cited in Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" Center for Strategic and International Studies, August 2012

²⁸ Financial Times, "Finds that form a bedrock of hope", April 22, 2012, <http://www.ft.com/intl/cms/s/0/e04264c8-8a2e-11e1-a0c8-00144feab49a.html#axzz2702pkwB9>

²⁹ Vidas, Harry and Hugman, Robert, "Recent Published Assesments of India's Shale Gas Potential – Are They Realistic?" ICF International, March 2012

³⁰ Ibid.

Map 1: Potential Shale-Gas Bearing Sedimentary Basins of India



Source: Directorate General of Hydrocarbons. "Indian Sedimentary Basins" Directorate General of Hydrocarbons Website, October 2012, http://www.dghindia.org/Images/Sedimentary_Map.jpg

Securing Reliable Partners for Imports

The consensus opinion amongst an overwhelming majority of experts is that India's domestic shale gas industry is still at a very nascent stage. Exploration and exploitation of shale gas reserves will require acquisition of advanced exploration technologies and significant amounts of drilling. In the best case scenario, commercialization of new discoveries is at least 5-7 years away.³¹ By 2015, the demand for gas in India is projected to rise by approximately 40% while aggregate domestic output will only rise 8.7%.³² In the interim, India will need to secure reliable partners to import gas, as dependably, cheaply and efficiently as possible, to cover the supply shortfall until domestic reserves come online. India should look to hedge its supply risks by diversifying the sources for its LNG imports, providing resilience against supply interruptions due to adverse geopolitical scenarios. Currently, Qatar is the largest supplier of LNG to India, followed by Australia, Trinidad and Tobago and Russia.³³ The average price paid by India for imported LNG ranges between \$15-\$17/mmbtu and is as high as \$19 in many cases.³⁴ As the proportion of LNG in India's overall energy mix increases, prices have the potential to trigger a substantial escalation in the cost of electricity and cause fuel inflation across the economy.

From this perspective, the United States should be considered a prime candidate as a future partner, not least because of the price of gas at Henry Hub, which has been currently hovering at a little over \$2.5 per million British thermal unit (mmbtu), as a result of the dramatic increase in gas-drilling projects taken in the past two years.³⁵ Furthermore, the price in the U.S. is expected to remain among the lowest in the world even after it stabilizes around \$4-\$6/mmbtu.³⁶ As per most estimates, the loaded cost of U.S. gas to India should

³¹ Dar, Vinod. "Emerging International Shale Gas: Poland and China Lead" *Right Side News*, January 14, 2011 as cited in Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" Center for Strategic and International Studies, August 2012

³² Sharma, Rakesh. "Why India Wants US Gas" *The Wall Street Journal*, June 4 2012. Web. <http://blogs.wsj.com/indiarealtime/2012/06/04/why-india-wants-u-s-gas/>

³³ Corbeau, Anne-Sophie, "Natural Gas in India" *International Energy Agency*, 2010. Web. September 9, 2012. http://www.iea.org/publications/freepublications/publication/natural_gas_india_2010.pdf

³⁴ *ibid*

³⁵ "An Unconventional Bonanza." *The Economist* July 14, 2012: 43. Print

³⁶ *ibid*

be around \$10—\$ 11/mmbtu after factoring in transportation costs, significantly lower than India’s current import prices.³⁷ By exporting shale gas to India, the U.S. can contribute to India’s emergence as an economic power and reduce its energy dependence on Gulf and Iranian oil.

This process, however, is not without its hurdles. Currently, the U.S. has eight terminals being equipped to liquefy gas for export in specialized tankers.³⁸ Despite the tremendous surplus in the country, U.S. lawmakers are concerned that exports could initiate a substantial increase in domestic gas prices and adversely impact the still feeble domestic economy. In January 2012, the EIA forecast that increased exports of gas could drive up domestic gas prices by as much as 54% by 2018.³⁹ Therefore, until a comprehensive study on the economic implications of exporting U.S. gas is completed, tight restrictions have been implemented that limit exports to countries that have entered into free trade agreements (FTAs) with the U.S.

However, Cheniere Energy based in Houston, Texas has applied for and obtained permission to export limited quantities of U.S. gas from its Sabine Pass Terminal in Southwestern Louisiana to nations other than those which have signed a free trade agreement (FTA) with the United States Government.⁴⁰ GAIL has seized the opportunity to sign a contract to import 3.5 MMT/y of LNG from Sabine Pass, but this represents only a tiny fraction of the massive surplus gas in the U.S. or even India’s total import requirement.⁴¹

The Cheniere facility was originally designed as an import terminal in the days prior to the U.S. shale gas-glut, when the country was still expecting to import gas to meet its needs,

³⁷ Katakey, Rakteem. “Lowest US Gas Price Since 1999 Attracts GAIL: Corporate India” *Bloomberg News*, September 18, 2012. Web. <http://www.bloomberg.com/news/2012-09-17/lowest-u-s-gas-price-since-1999-attracts-gail-corporate-india.html>

³⁸ “The US Should Ease Rules for LNG Exports says GAIL.” *The Economic Times*, July 30, 2012. Print. http://articles.economictimes.indiatimes.com/2012-07-30/news/32942343_1_cheniere-energy-shale-gas-carrizo-oil

³⁹ Sharma, Rakesh. “Why India Wants US Gas” *The Wall Street Journal*, June 4 2012. Web. <http://blogs.wsj.com/indiarealtime/2012/06/04/why-india-wants-u-s-gas/>

⁴⁰ Ibid.

⁴¹ “GAIL inks 20-year LNG import deal with US firm Sabine Pass Liquefaction.” *The Economic Times*, December 12, 2012. Web. <http://economictimes.indiatimes.com/news/news-by-industry/energy/oil-gas/gail-inks-20-year-lng-import-deal-with-us-firm-sabine-pass-liquefaction/articleshow/11076530.cms>

and is undergoing extensive overhaul to be reequipped for export purposes. It is expected to reach peak operability only by 2015-16, perhaps not soon enough for many Indian entities.⁴² Furthermore, Cheniere's export permit could be reviewed at any time, possibly even before the first shipment of LNG to India commences.⁴³

The third India-U.S. Strategic Dialogue held on June 13, 2012 gave considerable importance to bilateral cooperation in the area of energy, covering cooperation on shale and other unconventional gas potential in India, hydrocarbon potential in the Indian Ocean and other regions, stable supplies of natural gas for India, and India's interest in LNG imports from the U.S. (which will require lifting of current U.S. Government restrictions which limit exports to FTA partners).⁴⁴

Similarly, the India-U.S. Energy Dialogue held on September 20, 2012 welcomed the enormous trade and investment opportunities which have opened up with the discovery of U.S. shale gas. While noting the investments already made in this sector by Indian companies and the permission granted to GAIL for the export of LNG from the Sabine Pass terminal in the U.S. to India, the Dialogue also discussed the impact of relatively less expensive LNG imports from the U.S. for prospects of economic growth in India.

Chandrashekhar Dasgupta, Distinguished Fellow at The Energy and Resources Institute (TERI) in New Delhi, has argued that U.S. policies, such as sanctions against Iran, impose indirect burdens on its friends and damage energy security interests of India as well as other U.S. partners in Asia.⁴⁵ Iran sanctions have caused a major reduction in gas supplies for Asian markets and precluded the most economical routes through which Caspian and Central Asian energy can be brought to international markets. Given India's close and

⁴²Cheniere Energy Partners LLP, "Liquefaction Project Schedule." web
http://www.cheniereenergypartners.com/liquefaction_project/project_schedule.shtml

⁴³Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" *Center for Strategic and International Studies*, August 2012. print

⁴⁴Joint Statement on the Third US-India Strategic Dialogue: *The U.S. Department of State*, June 14, 2012. Web
<http://www.state.gov/r/pa/prs/ps/2012/06/192267.htm>

⁴⁵Dasgupta, Chandrashekhar. "The Changing Geopolitics of Energy – US shale gas policy will impact its global role" .

multifaceted ties with the U.S., it has borne the burden of collateral damage by consistently cutting down on oil supplies from Iran. It is, therefore, fair for India to expect that the U.S. will not deny it access to the North American shale gas market⁴⁶.

Such expectations from India are hardly unusual. Japan, which is a long-standing security ally of the U.S., is also expecting an exemption from the U.S. Department of Energy enabling it to source American shale gas.

India would of course welcome an exemption which enables it to import greater volumes of gas as well as the use of the other LNG export terminals in the U.S., but the outcome of its diplomatic efforts remains to be seen. However, commitments from both sides towards accelerating collaboration on exploration and development of unconventional gas resources present a silver lining that may prove decisive in the realization of India's domestic shale gas ambitions.

⁴⁶ Dasgupta, Chandrasekhar. "The Changing Geopolitics of Energy – US shale gas policy will impact its global role".

IV. Domestic Challenges

Development of Infrastructure

At home, the key challenge for India will lie in developing the infrastructure for transmission and distribution of gas. The cross-continent transportation of gas in particular requires specialized facilities at both ends. At the supply end, liquefaction facilities cool gas to -161 degrees Celsius, whereafter the liquid gas is transported by special tankers to the receiving terminal and converted back into gas to be stored in high-pressure tanks or pumped into a pipeline to end-users.⁴⁷

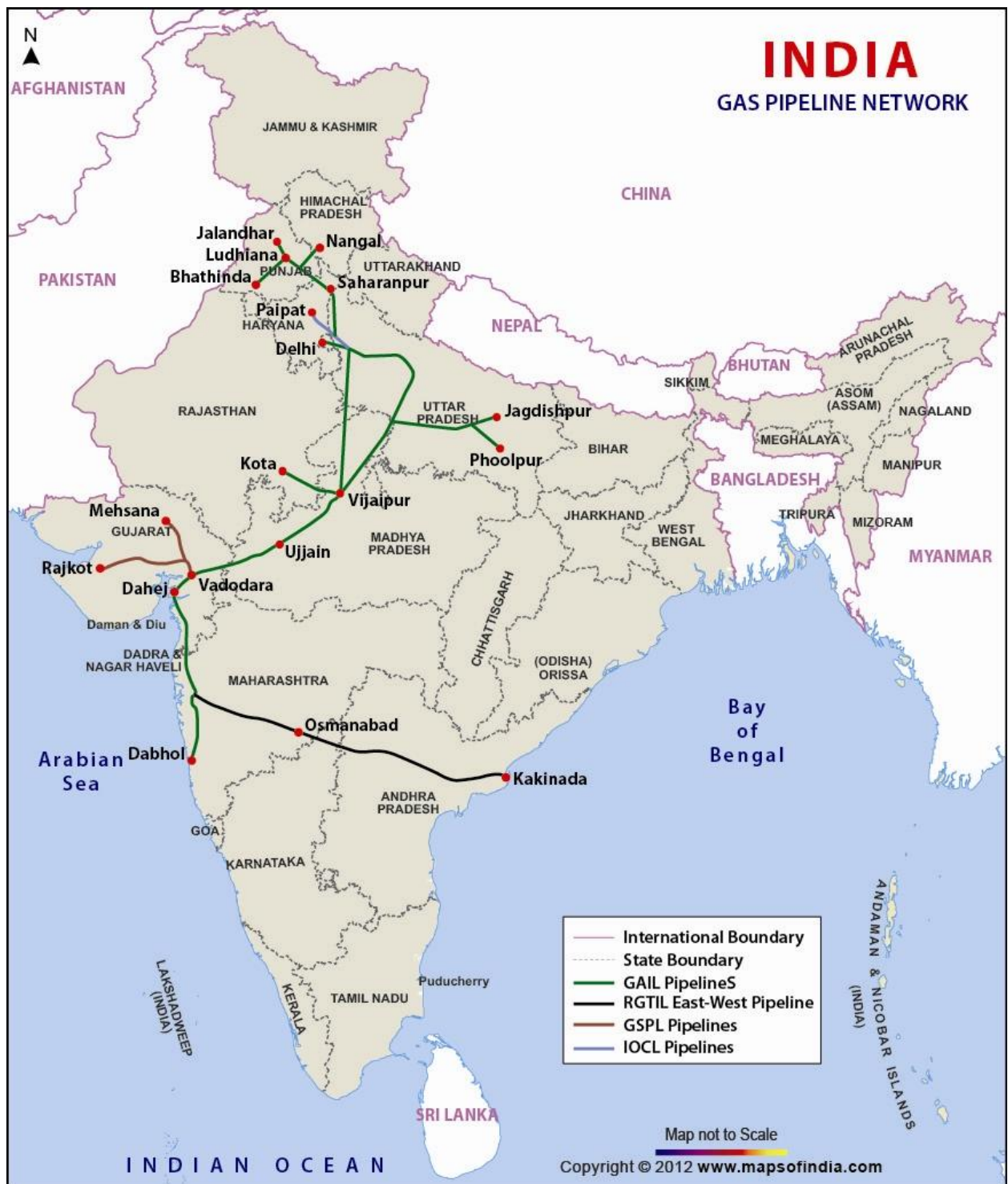
To fully capitalize on its gas potential, India first and foremost requires accelerated and extensive development of its domestic pipeline network in order to bring the gas from these terminals to end-users efficiently. GAIL operates a 6,600 km gas pipeline running northward from Dabhol to New Delhi via Dahej that forms the artery of the country's gas supplies, transporting over 80% of all gas consumed within the country.⁴⁸ This is complemented by a 1,440 km pipeline operated by Reliance that traverses the breadth of the country forming the main east-west link.⁴⁹ Pipeline networks that link these terminals to end users in the south or eastern states, both important centers of industry in the country, are conspicuously absent. Existing as well as planned pipeline networks can be seen in Map 2.

⁴⁷ An Unconventional Bonanza." *The Economist* July 14,2012: 43. Print

⁴⁸ Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" *Center for Strategic and International Studies*, August 2012. Print.

⁴⁹ Ibid.

Map 2: India's Pipeline Network



Source: Maps of India

Concurrently, India will also need to vastly increase its maritime import capacity by investing in the construction of gasification terminals and commissioning specialized LNG transport ships. At present, India's operational regasification terminals are Petronet LNG's Dahej

facility and Shell-Total's Hazira terminal in Gujarat, with capacities of 6.5 and 3.6 million metric tonnes per year (MMT/y) respectively.⁵⁰ The Indian government expects LNG imports to top 20 MMT/y by 2017, more than twice the country's current capacity.⁵¹ Additional terminals in the pipeline include Indian Oil's facility at Ennore, the Adani Group's Mundra and Mangalore terminals and Petronet's plant at Kochi. Along with expansion projects at current terminals, these additions are expected to raise the import capacity by approximately 17.5 MMT/y if all goes as planned.⁵²

Policy and Regulatory Reforms

A critical policy change by the Indian government that permits 100 percent ownership in gas pipeline projects by private and public Indian companies as well as foreign investors is certainly a step in the right direction. This move will encourage investments in expansion of the pipeline network, without which the gas industry will be prone to befalling the same fate as the coal industry which is hamstrung by infrastructural bottlenecks. However, there are several regulatory and pricing policies that need to be addressed, including:

- i. **Allocation of Resources:** In the wake of the twin debacles of allocation of coal blocks and telecom spectrums, this issue will be the subject of much scrutiny. The government may seek to apply lessons learned by implementing an allocation procedure that is efficient, fair and transparent. As authors of the CSIS report have noted, the process will be complicated by the fact that shale-gas often occurs in the same surface environments as coal-bed methane (CBM) resources, which are auctioned per the block system by the Directorate General of Hydrocarbons (DGH).⁵³ The government will have to reconcile regulations on the

⁵⁰ U.S. Energy Information Administration, "Country Analysis Brief: India," November, 2011, <http://www.eia.gov/countries/cab.cfm?fips=IN>

⁵¹ "LNG traders flock to Singapore to tap China, India demand." *Reuters*, February 28, 2011 as cited in Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" Center for Strategic and International Studies, August 2012

⁵² Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" *Center for Strategic and International Studies*, August 2012. print

⁵³ *Ibid.*

two resources, and streamline access to each block with the minimum room for conflict.

- ii. **Land Acquisition:** As drilling operations eventually move onshore, the acquisition is likely to become a contentious issue and pose a major challenge to development of inland shale gas resources. The central government will need to devise transparent regulations that assure adequate and fair compensation at market prices and resettlement of any displaced persons.
- iii. **De-regularization of Prices:** As multiple experts have noted, de-regularization of prices will also be a critical step in unfettering the growth potential of India's domestic gas industry. Currently India has over 27 pricing regimes for gas, organized on the basis of industry, and in nearly all cases, heavily subsidized.⁵⁴ The current pricing policy will have to be reassessed in order to incentivize development of the domestic industry through investment and increased participation of the private sector, while also providing gas at economical rates for Indian industry.

Acquisition of Technology and Expertise

Acquisition of technology will be the determining catalyst in the advancement of India's gas ambitions. The acquisition of advanced exploration as well extractive technologies should be the foremost priority. Exploration is key for identifying additional resources, as currently only a small fraction of India's potential resource base has been explored. Speaking at a conference in New Delhi in October, 2012, Vikram Mehta, CEO of Shell India emphasized the importance of advanced extractive methods to the success of India's shale gas ambitions.

⁵⁴ Ebinger, Charles, "Energy Security and the India-U.S. Relationship", Brookings-FICCI Dialogue on the India-U.S. Strategic Partnership, FICCI, Tansen Marg, New Delhi, India, October 9-10, 2012.

He noted that India's current recovery rates across the oil and gas industry average 28%, well below the global average of 40%.⁵⁵

The previously cited CSIS report has stressed the importance of acquiring technical and operational capability to supplement India's current capacity⁵⁶. India's energy majors have aggressively pursued both upstream and downstream acquisitions in the shale gas sector abroad, particularly in North America. RIL, GAIL, ONGC, Oil India have all accumulated a sizeable portfolio of acreage on the U.S. Eagle and Marcellus shales.⁵⁷ Even as they seek to cash in on the U.S. shale gas bonanza, these acquisitions will also provide these operators operational expertise in across-the board management of large-scale gas operations that can be employed back in India in the future.

Environmental Concerns

India's nascent shale-gas industry faces major challenges to its growth in the form of environmental concerns which have surrounded the shale-gas drilling process globally. In Europe, environmental considerations have led many nations in the EU to place a moratorium on domestic drilling for shale-gas, even as they continue to import natural gas from other sources. The global debate centers on a host of issues that include the contamination of water aquifers, disposal of hazardous drilling fluids, the instigation of earthquakes and strain on water supplies.

As the CSIS report has noted, the issue of water usage will be critical for India, a country that struggles to meet its high demand for water even for more basic purposes such as drinking, domestic use and agriculture.⁵⁸ Fracking utilizes vast volumes of water that are

⁵⁵ Mehta, Vikram. Remarks made at the Brookings-FICCI Dialogue on the India-U.S. Strategic Partnership, FICCI, Tansen Marg, New Delhi, India, October 9-10, 2012

⁵⁶ Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" *Center for Strategic and International Studies*, August 2012. print

⁵⁷ "India Inc. seeks waiver from US to import fuel, acquire assets." Article. *Times of India*, June 19, 2012. web http://articles.timesofindia.indiatimes.com/2012-06-19/india-business/32317034_1_shale-gas-b-c-tripathi-henry-hub

⁵⁸ Nakano, Pumphrey, Price and Walton, "Prospects for Shale Gas Development In Asia: Examining potentials and Challenges in China and India" *Center for Strategic and International Studies*, August 2012. print

pumped into fissures in subterranean formations carrying sand and other materials that hold open cracks to allow the flow of gas into the collection well. As the Schlumberger report and Map 1 indicate, India's offshore basins that have been the focus of exploration and development initiatives to date hold only a small fraction of its total reserves. The vast majority of the country's unconventional gas potential lies in inland basins in the subcontinent's hinterland, which already faces critical water shortages.

The government will need to frame and enforce strict regulations to mitigate the environmental concerns that will arise as India's shale gas industry expands. Nonetheless, until alternative methods can be developed, the acute scarcity of water is likely to inhibit the full development of India's inland shale-gas potential and will require serious consideration by the Indian government.

V. Conclusion

Immense challenges lie ahead for India on energy security. These include the immediate need to bridge the energy deficit and the longer-term issue of securing the country's energy future in the light of a growing population and economy. While coal is likely to remain the staple of India's energy consumption, a reduction in the price advantage it has enjoyed due to increasing reliance on imports will pave the way for other alternatives to play a bigger role in India's primary energy. With nuclear and renewable sources unlikely to gain sufficient ground in the next two decades to alter the overall energy basket, gas will be increasingly called upon to fill the niche role of a bridge fuel in India.

Given the medium-term outlook of high prices of imported LNG, India must pursue the rapid development of its own unconventional gas resources, which according to some estimates are considerable. However, the country remains behind the curve on many aspects related to exploration and development, infrastructure and regulatory regimes pertaining to pricing, resource allocation and the environment.

In the interim, the shale-gas surplus in the Americas presents an opportunity to boost India's LNG supplies, though diplomatic hurdles will need to be overcome to realize this prospect.

India will need to fast track several initiatives, both at home and abroad. These include:

1. Acquisition of exploration and drilling technology for domestic resources
2. Development of gas transportation infrastructure, both international and domestic
3. Negotiation of access to additional U.S. shale gas resources and export terminals
4. Deregulation of domestic gas pricing
5. Environmental regulations for the shale gas industry

While there is no silver-bullet solution to all of India's energy problems, shale gas is a viable solution in the medium-term as India expands its non-conventional generation capacity, and beyond as a strategic reserve to frontline generation facilities. If systematically implemented, the gas alternative can serve India's energy needs well into the future.

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